

# ELECTRONIC POWER STEERING SYSTEM

## PRECAUTION

### 1. HANDLING PRECAUTION

- (a) When handling the electronic parts:
  - Avoid any impact to electronic parts such as ECUs and relays. Replace with new ones if dropped or subjected to a severe blow.
  - Do not expose any electronic parts to high temperatures and humidity.
  - Do not touch the connector terminals in order to prevent deformation or malfunctions due to static electricity.
- (b) When handling the steering column assembly:
  - Avoid any impact to the steering column assembly, especially to the motor and torque sensor. Replace with new ones if dropped or subjected to a severe blow.
  - Do not pull the wire harness when moving the steering column assembly.
- (c) When disconnecting and reconnecting the connectors:

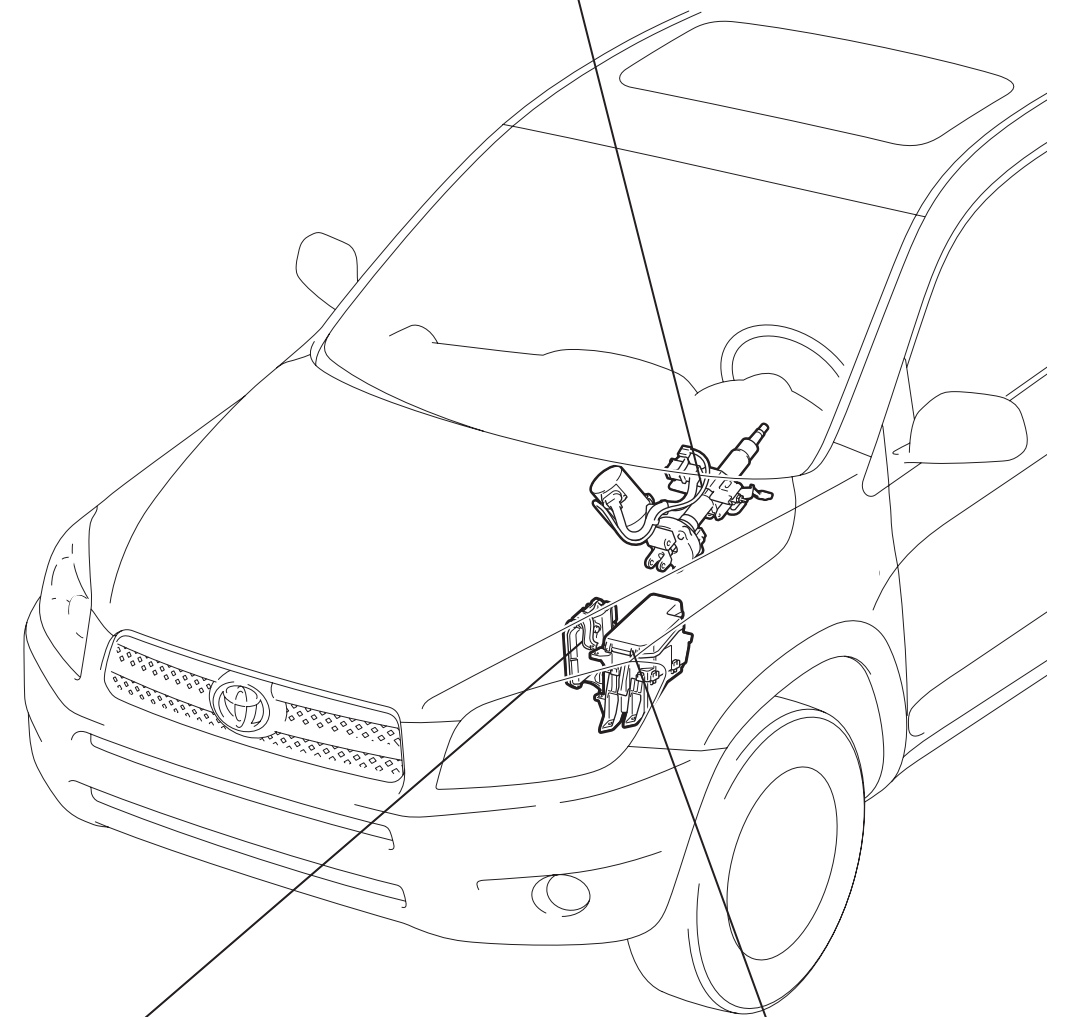
When disconnecting the connectors related to the electronic power steering system, turn the ignition switch ON, center the steering wheel, turn the ignition switch off, and then disconnect the connectors.

### 2. PRECAUTIONS FOR CAN COMMUNICATION

- (a) CAN communication lines are used to receive information from the skid control ECU and the ECM, and to transmit warnings to the combination meter. When there are any problems in the CAN communication lines, DTCs of the CAN communication line are output.
- (b) Perform troubleshooting for the communication line problems when the CAN communication DTCs are output. Be sure to start troubleshooting on the electronic power steering system after confirming that the CAN communication system is normal.
- (c) Since the CAN communication line has its own length and route, it cannot be repaired temporarily with a bypass wire, etc.

## PARTS LOCATION

STEERING COLUMN ASSEMBLY  
- POWER STEERING MOTOR  
- TORQUE SENSOR  
- MOTOR ROTATION ANGLE SENSOR



ECM

ENGINE ROOM NO. 1 RELAY BLOCK  
- EPS FUSE

PS

POWER STEERING ECU

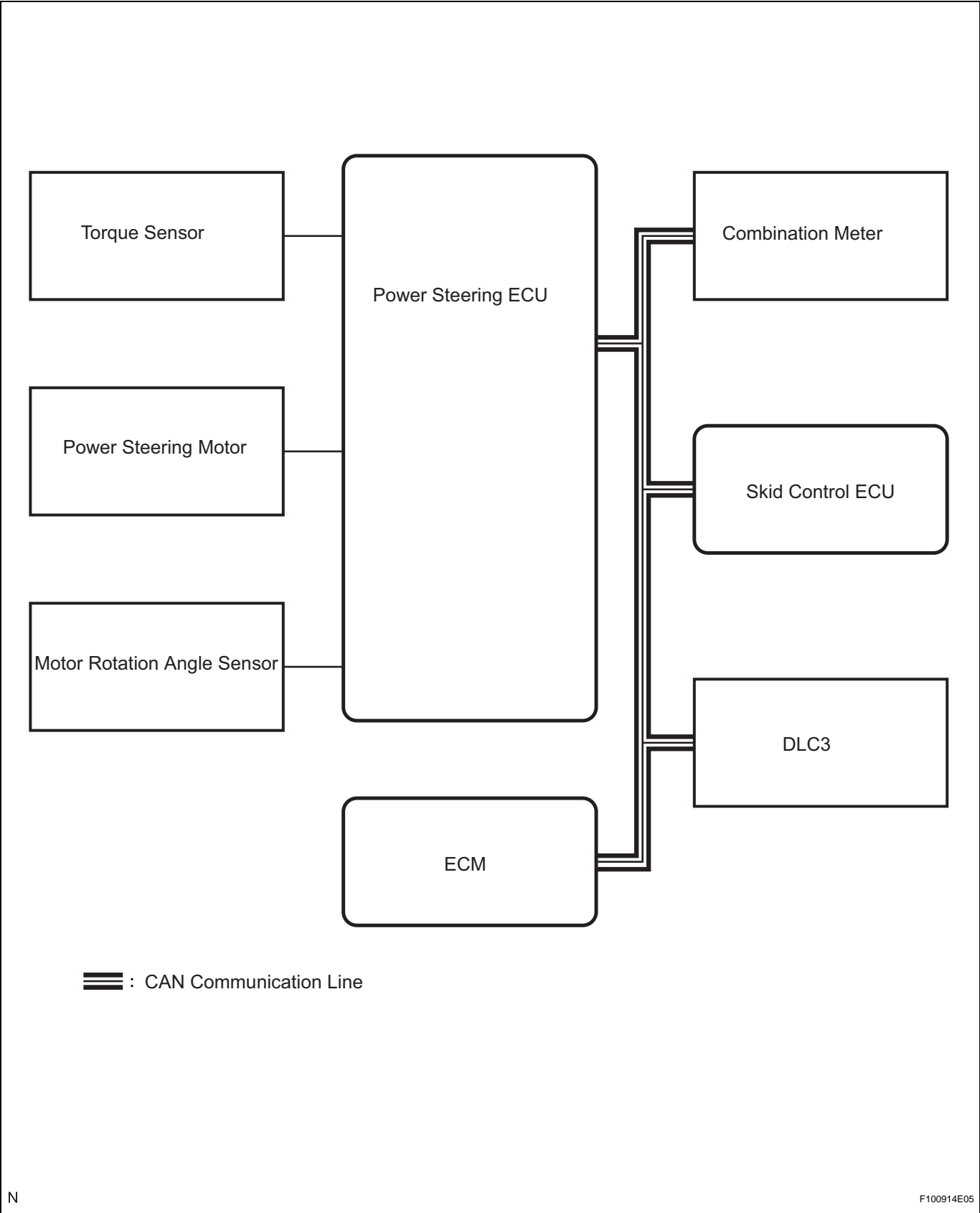
COMBINATION METER  
- P/S WARNING LIGHT

DLC3

INSTRUMENT PANEL JUNCTION BLOCK  
- IG1 RELAY  
- ECU-IG1 FUSE

PS

SYSTEM DIAGRAM



## SYSTEM DESCRIPTION

### 1. DESCRIPTION

The EPS (Electronic Power Steering) system generates torque through the operation of the motor and the reduction gear installed on the column shaft in order to assist steering effort.

The power steering ECU determines directions and the amount of assisting power in accordance with vehicle speed signals and signals from the torque sensor built into the steering column assembly. As a result, the power steering adjusts the steering effort so that it is lighter during low speed driving and heavier during high speed driving.

(a) Power steering ECU:

The power steering ECU calculates assisting power based on steering torque signals from the torque sensor and vehicle speed signals from the skid control ECU.

(b) Torque sensor:

The torque sensor detects the steering effort generated when the steering wheel is turned and converts it to an electrical signal.

(c) EPS motor:

The EPS motor is activated by the current from the power steering ECU and generates torque to assist the steering effort.

(d) Motor rotation angle sensor:

The motor rotation angle sensor consists of the resolver sensor, which excels in reliability and durability. The rotation angle sensor detects the rotation angle of the motor and outputs it to the power steering ECU. As a result, it ensures efficient EPS control.

## HOW TO PROCEED WITH TROUBLESHOOTING

HINT:

Perform troubleshooting in accordance with the following flowchart.

\*: Use the intelligent tester.

### 1 VEHICLE BROUGHT TO WORKSHOP

NEXT

### 2 INSPECT BATTERY VOLTAGE

**Standard voltage:**

**11 to 14 V**

If the voltage is below 11 V, recharge or replace the battery before proceeding.

NEXT

### 3 PROBLEM SYMPTOM CONFIRMATION

NEXT

PS

### 4 CHECK CAN COMMUNICATION SYSTEM\*

(a) Check for DTC (see page [PS-11](#)).

**Result**

Result	Proceed to
CAN system DTC is not output	A
CAN system DTC is output	B

HINT:

- When any CAN communication system DTCs are output, perform troubleshooting on the CAN communication system first.
- When communication to the power steering ECU is not established through the intelligent tester, inspect terminals SIL of the DLC3 and the power steering ECU, and the IG circuit of the power steering ECU.

**B**

**PROCEED TO CAN COMMUNICATION SYSTEM**

**A**

**5 CHECK DTC\***

(a) Check for DTC (see page [PS-11](#)).

**Result**

Result	Proceed to
DTC is output	A
DTC is not output	B

**A****Go to step 8****B****6 PROBLEM SYMPTOMS TABLE****Result**

Result	Proceed to
Fault is not listed in problem symptoms table	A
Fault is listed in problem symptoms table	B

**B****Go to step 8****A****7 OVERALL ANALYSIS AND TROUBLESHOOTING\***

- (a) Terminals of ECU (see page [PS-8](#)).  
(b) DATA LIST / ACTIVE TEST (see page [PS-14](#)).

**NEXT****8 REPAIR OR REPLACE****NEXT****9 CONFIRMATION TEST****NEXT****END**

## PROBLEM SYMPTOMS TABLE

### HINT:

Use the table below to help determine the cause of the problem symptom. The potential causes of the symptoms are listed in order of probability in the "Suspected area" column of the table. Check each symptom by checking the suspected areas in the order they are listed. Replace parts as necessary.

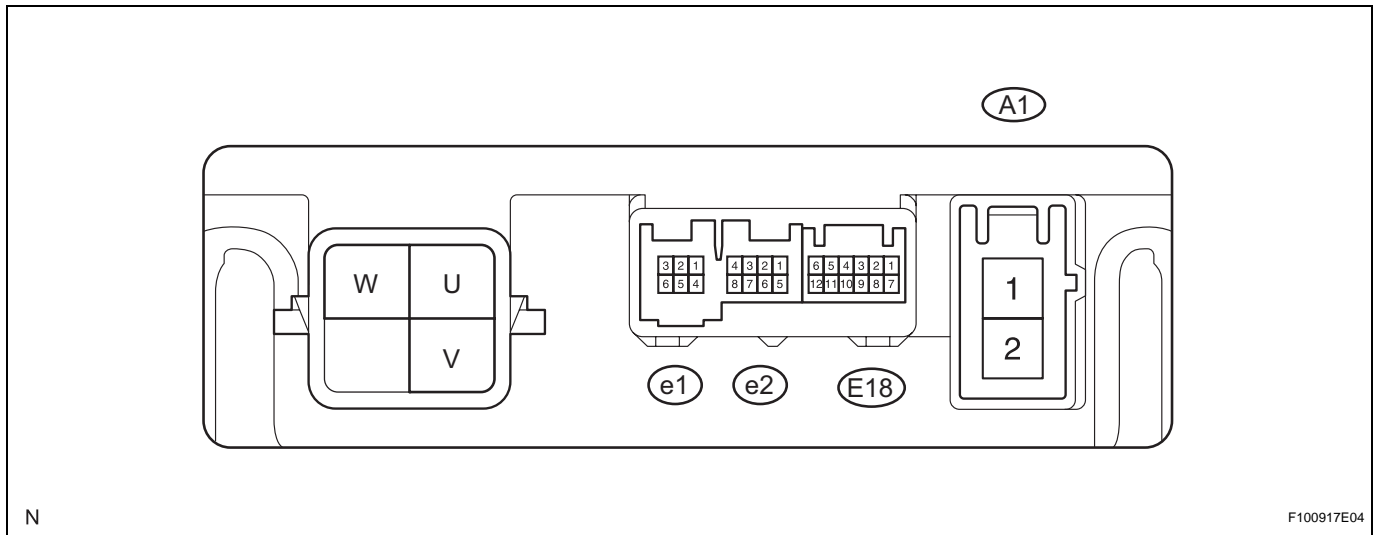
### Electronic power steering system

Symptom	Suspected area	See page
Heavy steering	1. Front tires (improperly inflated, unevenly worn)	<a href="#">TW-1</a>
	2. Front wheel alignment (incorrect)	<a href="#">SP-3</a>
	3. Front suspension (lower ball joint)	<a href="#">SP-27</a>
	4. Steering gear assembly	<a href="#">PS-42</a>
	5. Power steering motor	PS-25
	6. Power source voltage of power steering ECU	<a href="#">PS-37</a>
	7. Power steering ECU	<a href="#">PS-46</a>
Steering effort differs between turning right and left, or steering effort uneven	1. Front tires (improperly inflated, unevenly worn)	<a href="#">TW-1</a>
	2. Front wheel alignment (incorrect)	<a href="#">SP-3</a>
	3. Front suspension (lower ball joint)	<a href="#">SP-27</a>
	4. Steering gear assembly	<a href="#">PS-42</a>
	5. Torque sensor (built into steering column)	PS-22
	6. Steering column assembly	<a href="#">SR-11</a>
	7. Power steering motor	PS-25
	8. Power steering ECU	<a href="#">PS-46</a>
While driving, steering effort does not change in accordance with vehicle speed or steering wheel does not return properly	1. Front suspension (lower ball joint)	<a href="#">SP-27</a>
	2. Speed sensor	<a href="#">BC-28</a>
	3. Skid control ECU	<a href="#">BC-41</a>
	4. Torque sensor (built into steering column)	PS-22
	5. Power steering motor	PS-25
	6. Power steering ECU	<a href="#">PS-46</a>
	7. Controlling CAN communication system	<a href="#">CA-8</a>
Friction occurs when turning steering wheel during low speed driving	1. Power steering motor	PS-25
	2. Steering column assembly	<a href="#">SR-11</a>
High-pitched sound (squeaking) occurs when turning steering wheel slowly with vehicle stopped	1. Power steering motor	PS-25
Steering wheel vibrates and noise occurs when turning steering wheel with vehicle stopped	1. Power steering motor	PS-25
	2. Steering column assembly	<a href="#">SR-11</a>
P/S warning always indicated on combination meter	1. Power source voltage of power steering ECU	<a href="#">PS-37</a>
	2. Combination meter	<a href="#">ME-53</a>
	3. Power steering ECU	<a href="#">PS-46</a>



## TERMINALS OF ECU

### 1. CHECK POWER STEERING ECU



#### HINT:

Measurements cannot be performed on the C connector side of the power steering ECU.

Symbols	Wiring Color	Terminal Description
U	W	U phase motor output
V	B	V phase motor output
W	W-R	W phase motor output

(a) Measure the voltage and resistance of the connectors.

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
PIG (A1-1) - PGND (A1-2)	W-B - W-B	Power source	Always	10 to 14 V
IG (E18-5) - PGND (A1-2)	L - W-B	IG power source	Ignition switch ON	10 to 14 V
TRQ1 (e1-6) - TRQG (e1-1)	G - B	Torque sensor signal	Ignition switch ON Steering wheel not turned (without load)	2.3 to 2.7 V
			Ignition switch ON Steering wheel turned to right with vehicle stopped	2.5 to 4.04 V
			Ignition switch ON Steering wheel turned to left with vehicle stopped	0.95 to 2.5 V
TRQ2 (e1-2) - TRQG (e1-1)	Y - B	Torque sensor signal	Ignition switch ON Steering wheel not turned (without load)	2.3 to 2.7 V
			Ignition switch ON Steering wheel turned to right with vehicle stopped	0.95 to 2.5 V
			Ignition switch ON Steering wheel turned to left with vehicle stopped	2.5 to 4.04 V
TRQF (e1-4) - TRQG (e1-1)	W - B	Torque sensor reference voltage	Ignition switch ON	3.35 to 3.37 V
TRQV (e1-3) - TRQG (e1-1)	R - B	Torque sensor voltage source	Ignition switch ON	8.5 to 10.5 V
TRQG (e1-1) - Body ground	B - Body ground	Torque sensor ground	Always	Below 1 $\Omega$

Symbols (Terminal No.)	Wiring Color	Terminal Description	Condition	Specified Condition
PGND (A1-2) - Body ground	W-B - Body ground	Power ground	Always	Below 1 $\Omega$
C1 (e2-1) - PGND (A1-2)	R - W-B	Resolver signal	Ignition switch ON Steering wheel is turned	0.68 to 4.42 V
C2 (e2-5) - PGND (A1-2)	L - W-B	Resolver signal	Ignition switch ON Steering wheel is turned	0.68 to 4.42 V
S1 (e2-2) - PGND (A1-2)	B - W-B	Resolver signal	Ignition switch ON Steering wheel is turned	0.68 to 4.42 V
S2 (e2-6) - PGND (A1-2)	Y - W-B	Resolver signal	Ignition switch ON Steering wheel is turned	0.68 to 4.42 V
R1 (e2-4) - PGND (A1-2)	W - W-B	Resolver excitation signal	Ignition switch ON Steering wheel is turned	2.9 to 5.1 V
R2 (e2-8) - PGND (A1-2)	G - W-B	Resolver excitation signal	Ignition switch ON Steering wheel is turned	2.9 to 5.1 V
CANH (E18-2) - CANL (E18-8)	Y - W	CAN communication line	Ignition switch OFF	54 to 67 $\Omega$

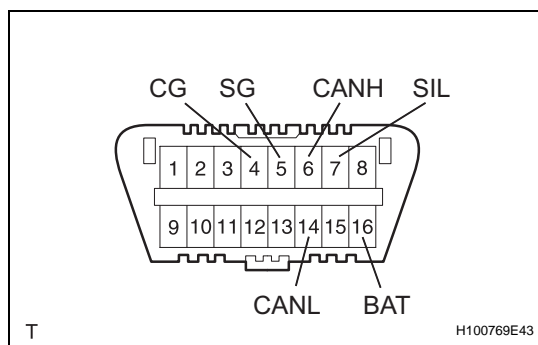
If the result is not as specified, the ECU may have a malfunction.

## DIAGNOSIS SYSTEM

### 1. CHECK DLC3

#### (a) Check the DLC3:

The power steering ECU uses CAN (ISO11898-1) and ISO9141-2 for communication protocol. The terminal arrangement of the DLC3 complies with SAE J1962 and matches the ISO9141-2 format.



PS

Symbols (Terminal No.)	Terminal Description	Condition	Specified Condition
SIL (7) - SG (5)	Bus [+] line	During transmission	Pulse generation
CG (4) - Body ground	Chassis ground	Always	Below 1 $\Omega$
SG (5) - Body ground	Signal ground	Always	Below 1 $\Omega$
BAT (16) - Body ground	Battery positive	Always	11 to 14 V
CANH (6) - CANL (14)	HIGH-level CAN bus line	Ignition switch OFF*	54 to 67 $\Omega$
CANH (6) - Battery positive	HIGH-level CAN bus line	Ignition switch OFF*	1 M $\Omega$ or higher
CANH (6) - CG (4)	HIGH-level CAN bus line	Ignition switch OFF*	200 $\Omega$ or higher
CANL (14) - Battery positive	LOW-level CAN bus line	Ignition switch OFF*	1 M $\Omega$ or higher
CANL (14) - CG (4)	LOW-level CAN bus line	Ignition switch OFF*	200 $\Omega$ or higher

### NOTICE:

**\*: Before measuring the resistance, leave the vehicle as is for at least 1 minute and do not operate the ignition switch, other switches or the doors.**

If the result is not as specified, the DLC3 may have a malfunction. Repair or replace the harness and connector.

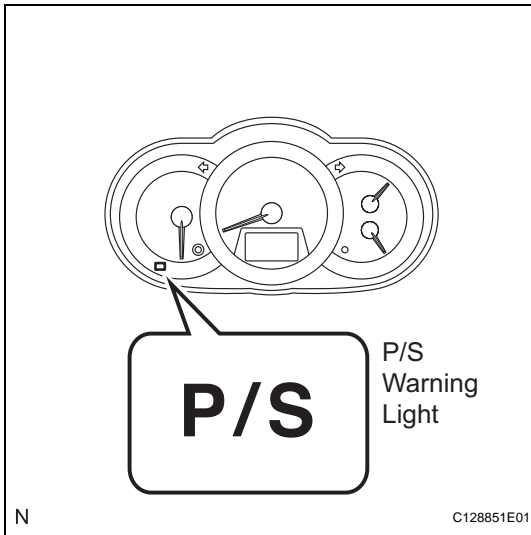
### HINT:

Connect the cable of the intelligent tester to the DLC3, turn the ignition switch ON and attempt to use the tester. If the display indicates that a communication error has occurred, there is a problem either with the vehicle or with the tester.

- If communication is normal when the tester is connected to another vehicle, inspect the DLC3 of the original vehicle.
- If communication is still not possible when the tester is connected to another vehicle, the problem may be in the tester itself. Consult the Service Department listed in the tester's instruction manual.

## 2. WARNING LIGHT

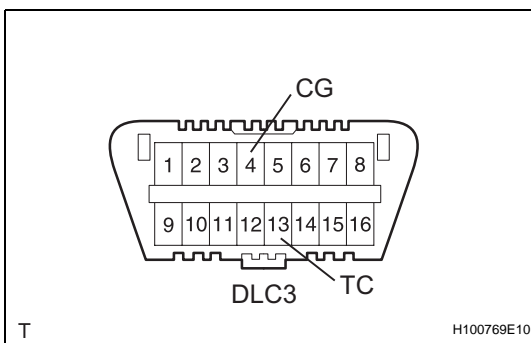
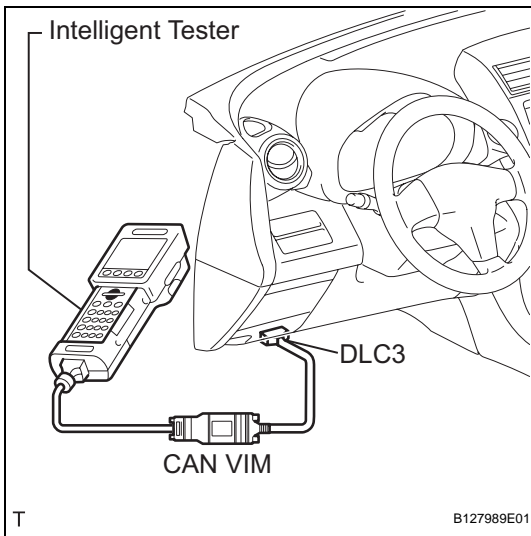
- (a) When a problem occurs in the electronic power steering system, the P/S warning light on the combination meter comes on to inform the driver of the problem.



## DTC CHECK / CLEAR

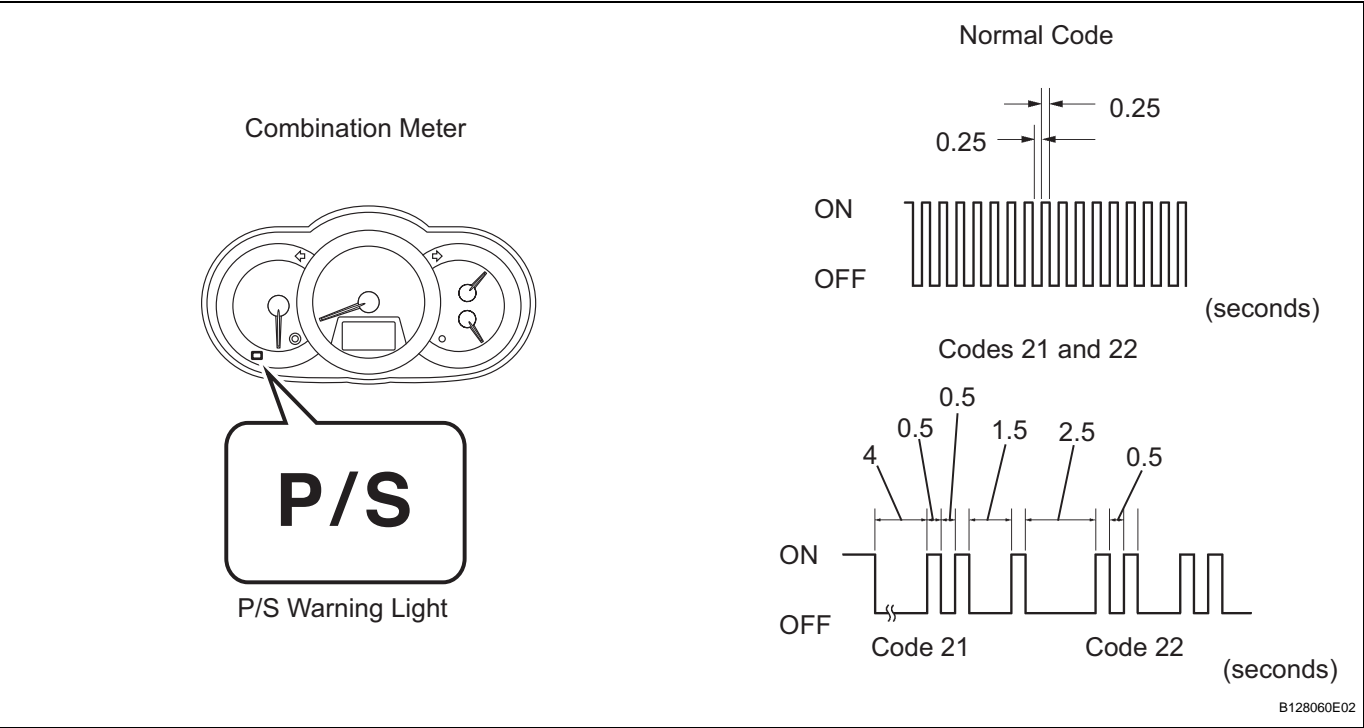
### 1. CHECK DTC

- (a) When using intelligent tester:
- (1) Connect the intelligent tester (with CAN VIM) to the DLC3.
  - (2) Turn the ignition switch ON and press the intelligent tester main switch ON.
  - (3) Read the DTCs by following the prompts on the intelligent tester.
- HINT:  
Refer to the intelligent tester operator's manual for further details.



- (b) When not using intelligent tester:
- (1) Using SST, connect terminals 13 (TC) and 4 (CG) of the DLC3.  
**SST 09843-18040**
  - (2) Turn the ignition switch ON.

- (3) Read and write down any DTCs indicated by the P/S warning light on the combination meter. Refer to the chart below for examples of a normal code and DTCs 21 and 22.



HINT:

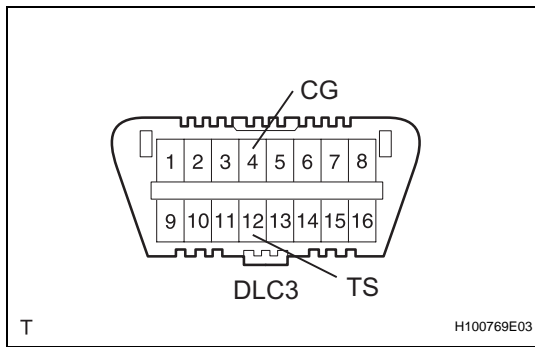
- If the P/S warning light does not blink to display any DTCs set or the normal code, inspect the circuit shown in the table below.

Trouble Area	See Page
EPS warning light circuit	<a href="#">PS-37</a>

- If two or more malfunctions are detected simultaneously, DTCs will be displayed in ascending numerical order.
- (4) Refer to the Diagnostic Trouble Code Chart (See page [PS-16](#)) for DTC information.

2. CLEAR DTC

- (a) When using intelligent tester:
- (1) Connect the intelligent tester (with CAN VIM) to the DLC3.
  - (2) Turn the ignition switch ON and press the intelligent tester main switch ON.
  - (3) Clear the DTCs by following the prompts on the intelligent tester.
  - (4) Turn the ignition switch OFF.
  - (5) Disconnect the intelligent tester from the DLC3.



- (b) When not using intelligent tester:
- (1) Using SST, connect terminals 12 (TS) and 4 (CG) of the DLC3.  
**SST 09843-18040**
  - (2) Turn the ignition switch ON.
  - (3) Disconnect the SST check wire from terminal 4 (CG) and reconnect it, and repeat this procedure 4 times or more within 8 seconds.
  - (4) Check that the P/S warning light blinking pattern is the normal code.
  - (5) Turn the ignition switch OFF.
  - (6) Remove SST from the DLC3.

## FREEZE FRAME DATA

### 1. FREEZE FRAME DATA

#### NOTICE:

- It is difficult to show the specified values (judgment values) clearly because freeze frame data values change significantly due to differences in measurement conditions, surroundings, or vehicle conditions. For this reason, there may be a problem even when the values are within specifications.
- Turn the ignition switch ON and park the vehicle on level ground. Check the freeze frame data by using intelligent tester.
  - (a) Connect the intelligent tester (with CAN VIM) to the DLC3.
  - (b) Turn the ignition switch ON and check the freeze frame data by following the prompts on the intelligent tester display.

#### Power steering ECU

Item	Item Description: Range (Display)	Inspection Condition	Reference Value
BATTERY VOLTAGE	Battery voltage: Min.: 0 V Max.: 25.5 V	-	10 to 14 V
SPD	Vehicle speed from meter: Min.: 0 km/h (0 mph) Max.: 300 km/h (187.5 mph)	Vehicle stopped	0 km/h (mph)
		Vehicle driven at constant speed	No significant fluctuation
ENGINE REV	Show the engine revolution: Min.: 0 rpm Max.: 12800 rpm	Engine is running at a constant speed	No significant fluctuation
MOTOR ACTUAL	Amount of current to motor: Min.: -327.68 A Max.: 327.67 A	Power steering is in operation	Value changes in proportion to steering effort
COMMAND VALUE	Demanded amount of current to motor: Min.: -327.68 A Max.: 327.68 A	Power steering is in operation	Value changes in proportion to steering effort
STR ANGL VEL	Steering angle speed: Min.: -32768°/sec. Max.: 32767°/sec.	Steering wheel is turned	Value changes in proportion to steering effort
STEERING TORQUE	Steering wheel torque: Min.: -7 Nm Max.: 7 Nm	-	-
THERMISTOR TEMP	ECU substrate temperature: Min.: -40°C Max.: 150°C	Ignition switch ON	-
PIG SUPPLY	Power source voltage to activate motor: Min.: 0 V Max.: 20.1531 V	Power steering in operation	10 to 14 V
IG SUPPLY	ECU power source voltage: Min.: 0 V Max.: 20.1531 V	Ignition switch ON	10 to 14 V
MOTOR ROTATE	Motor rotation angle: Min.: 0° Max.: 360°	Power steering in operation	During steering operation, motor rotation angle value changes from 0 to 360°
MOTOR VOLTAGE	Motor power supply voltage: 0 V Max.: 45.955 V	Power steering in operation	-

Item	Item Description: Range (Display)	Inspection Condition	Reference Value
MTR TERMINAL(U)	Motor terminal voltage (U phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
MTR TERMINAL(V)	Motor terminal voltage (V phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
MTR TERMINAL(W)	Motor Terminal voltage (W phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
PS ASSIST SIG	Power steering assist signal: ON or OFF	-	-

## FAIL-SAFE CHART

If a problem occurs in the electric power steering system, the P/S warning light will come on in the combination meter and steering power assist will be stopped, fixed at a particular point, or decreased simultaneously to protect the system.

### Electronic power steering system

DTC No.	Detection Condition	Fail-safe
C1511/11	Torque sensor malfunction	Power assist stops
C1512/11		
C1513/11		
C1514/11		
C1521/25	Motor malfunction	
C1524/24		
C1528/12	Motor rotation angle sensor malfunction	
C1531/25	ECU malfunction	
C1532/25		
C1534/25		
C1551/25	IG power source voltage error	
C1552/22	PIG power source voltage error	
C1554/23	Power source relay malfunction	
C1555/25	Motor relay malfunction	
C1533/25	ECU malfunction	Assist force restricted
U0073/49	CAN bus malfunction	Amount of power assist is locked at 140 km/h (87.5 mph) level of power assist
U0121/42	Skid control ECU communication error	
U0105/41	ECM communication error	Power assist stops

#### HINT:

The amount of power assist may be decreased to prevent the motor and ECUs from overheating if the steering wheel is continuously turned when the vehicle is either stopped or driven at a low speed, or if the steering wheel is kept at either full lock position for a long time. In such cases, the amount of power assist returns to normal if the steering wheel is not turned for approximately 10 minutes with the engine idling.



## DATA LIST / ACTIVE TEST

### 1. READ DATA LIST

#### HINT:

Using the intelligent tester's DATA LIST allows switch, sensor, actuator and other item values to be read without removing any parts. Reading the DATA LIST early in troubleshooting is one way to save time.

- Connect the intelligent tester (with CAN VIM) to the DLC3.
- Turn the ignition switch ON and press the intelligent tester main switch ON.
- Read the DATA LIST by following the directions on the tester screen.

Tester Display	Measurement Item/Range	Normal Condition	Reference Value
BATTERY VOLTAGE	Battery voltage: Min.: 0 V Max.: 25.5 V	-	10 to 14 V
SPD	Vehicle speed from meter: Min.: 0 km/h (0 mph) Max.: 300 km/h (187.5 mph)	Vehicle stopped	0 km/h (0 mph)
		Vehicle driven at constant speed	No significant fluctuation
SPD SIG INVALID	Record of vehicle speed signal invalid: REC or UNREC	-	UNREC
ENGINE REV	Show the engine revolution: Min.: 0 rpm Max.: 12800 rpm	Engine is running at a constant speed	No significant fluctuation
ENG REV INTER	Record of engine revolution signal interruption REC or UNREC	-	UNREC
MOTOR ACTUAL	Amount of current to motor: Min.: -327.68 A Max.: 327.67 A	Power steering is in operation	Value changes in proportion to steering effort
COMMAND VALUE	Demanded amount of current to motor: Min.: -327.68 A Max.: 327.68 A	Power steering is in operation	Value changes in proportion to steering effort
STR ANGL VEL	Steering angle speed: Min.: -32768°/sec. Max.: 32767°/sec.	Steering wheel is turned	Value changes in proportion to steering effort
STEERING TORQUE	Steering wheel torque: Min.: -7 Nm Max.: 7 Nm	-	-
THERMISTOR TEMP	ECU substrate temperature: Min.: -40°C Max.: 150°C	Ignition switch ON	-
PIG SUPPLY	Power source voltage to activate motor: Min.: 0 V Max.: 20.1531 V	Power steering in operation	10 to 14 V
IG SUPPLY	ECU power source voltage: Min.: 0 V Max.: 20.1531 V	Ignition switch ON	10 to 14 V
MTR OVERHEAT	Continuous overheat prevention control record: REC or UNREC	-	UNREC
MTR LOW POWER	PIG power source voltage drop record: REC or UNREC	-	UNREC

Tester Display	Measurement Item/Range	Normal Condition	Reference Value
MOTOR ROTATE	Motor rotation angle: Min.: 0° Max.: 360°	Power steering in operation	During steering operation, motor rotation angle value changes from 0 to 360°
MOTOR VOLTAGE	Motor power supply voltage: 0 V Max.: 45.955 V	Power steering in operation	-
MTR TERMINAL(U)	Motor terminal voltage (U phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
MTR TERMINAL(V)	Motor terminal voltage (V phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
MTR TERMINAL(W)	Motor Terminal voltage (W phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
IG ON/OFF TIMES	Ignition switch ON/OFF number of times after fail detection: Min.: 0 times Max.: 65535 times	-	-
# CODES	Number of detected DTCs when freeze frame data stored: Min.: 0 Max.: 255	-	-
PS ASSIST SIG	Power steering assist signal: ON or OFF	-	-

## 2. PERFORM ACTIVE TEST

### HINT:

Performing the intelligent tester's ACTIVE TEST allows relays, the VSV, actuators and other items to be operated without removing any parts. Performing the ACTIVE TEST early in troubleshooting is one way to save time. The DATA LIST can be displayed in the ACTIVE TEST.

- Connect the intelligent tester (with CAN VIM) to the DLC3.
- Turn the ignition switch ON and turn the intelligent tester ON.
- Perform the ACTIVE TEST by following the prompts on the tester.

### Combination meter

Tester Display	Test Part	Control Range
EPS INDIC	P/S indicator ON/OFF	Confirm that vehicle is stopped, engine idling

## DIAGNOSTIC TROUBLE CODE CHART

### HINT:

If any DTCs are displayed during the DTC check, inspect the circuit listed for these DTCs. For details of each DTC, refer to the page indicated in the DTC chart.

### Electric Power Steering System

DTC No.	Detection Item	Trouble Area	Normal Function Return Condition	P/S Warning Light	See page
C1511/11	Torque Sensor 1 Malfunction	- Steering column assembly (Torque sensor) - Power steering ECU	Ignition switch ON again	○	PS-18
C1512/11	Torque Sensor 2 Malfunction	- Steering column assembly (Torque sensor) - Power steering ECU	Ignition switch ON again	○	PS-18
C1513/11	Torque Sensor Deviation Excessive	- Steering column assembly (Torque sensor) - Power steering ECU	Ignition switch ON again	○	PS-18
C1514/11	Torque Sensor Power Supply Voltage Malfunction	- Steering column assembly (Torque sensor) - Power steering ECU	Ignition switch ON again	○	PS-18
C1521/25	Short in Motor Circuit	- Power steering ECU	Ignition switch ON again	○	PS-21
C1524/24	Motor Terminal Voltage Malfunction	- Steering column assembly (Torque sensor) - Power steering ECU	Ignition switch ON again	○	PS-22
C1528/12	Motor Rotation Angle Sensor Malfunction	- Steering column assembly (Torque sensor) - Power steering ECU	Ignition switch ON again	○	PS-24
C1531/25	ECU Malfunction	- Power steering ECU	Ignition switch ON again	○	PS-26
C1532/25	ECU Malfunction	- Power steering ECU	Ignition switch ON again	○	PS-26
C1533/25	Temperature Sensor Circuit is Low or High	- Power steering ECU	Ignition switch ON again or after normal confirmation	○	PS-26
C1534/25	EEPROM Malfunction	- Power steering ECU	Ignition switch ON again	○	PS-26
C1551/25	IG Power Supply Voltage Malfunction	- ECU-IG1 fuse - IG power source circuit - Power steering ECU	Ignition switch ON again or after normal confirmation	○	PS-27
C1552/22	PIG Power Supply Voltage Malfunction	- PIG power source circuit - Power steering ECU	Ignition switch ON again or after normal confirmation	○	PS-29
C1554/23	Power Supply Relay Failure	- PIG power source circuit - Power steering ECU	Ignition switch ON again	○	PS-31
C1555/25	Motor Relay Welding Failure	- Power steering ECU	Ignition switch ON again	○	PS-31
C1581/26	Assist Map Number Un-Writing	- Power steering ECU	Assist map write or ignition switch ON again	○	PS-32
U0073/49	Control Module Communication Bus Off	- CAN communication system	Ignition switch ON again	○	PS-34

DTC No.	Detection Item	Trouble Area	Normal Function Return Condition	P/S Warning Light	See page
U0105/41	Lost Communication with Fuel Injector Control Module	- CAN communication system - ECM	Ignition switch ON again or after normal confirmation	X	<a href="#">PS-34</a>
U0121/42	Lost Communication with Anti-Lock Brake System (ABS) Control Module	- CAN communication system - Skid control ECU	Ignition switch ON again or after normal confirmation	○	<a href="#">PS-34</a>

HINT:  
○: Warning light comes on  
X: Warning light turns off (normal reset)

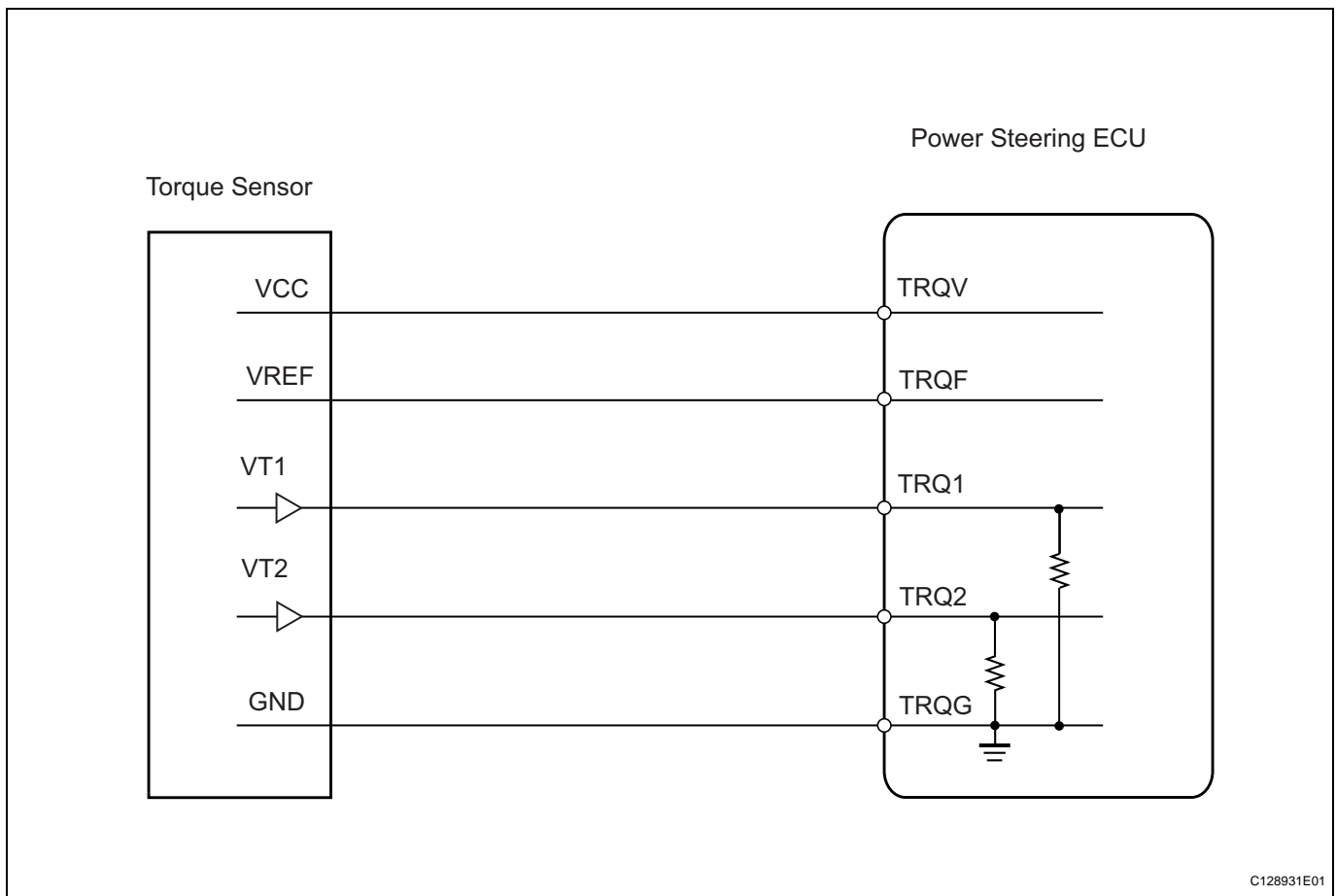
<b>DTC</b>	<b>C1511/11</b>	<b>Torque Sensor 1 Malfunction</b>
<b>DTC</b>	<b>C1512/11</b>	<b>Torque Sensor 2 Malfunction</b>
<b>DTC</b>	<b>C1513/11</b>	<b>Torque Sensor Deviation Excessive</b>
<b>DTC</b>	<b>C1514/11</b>	<b>Torque Sensor Power Supply Voltage Malfunction</b>

## DESCRIPTION

The torque sensor converts the rotation torque input from the steering wheel into electric signals and sends them to the power steering ECU.

DTC No.	DTC Detection Condition	Trouble Area
C1511/11	Torque sensor malfunction	<ul style="list-style-type: none"> <li>Torque sensor (built into steering column assembly)</li> <li>Power steering ECU</li> <li>Connector</li> </ul>
C1512/11		
C1513/11		
C1514/11		

## WIRING DIAGRAM



## INSPECTION PROCEDURE

**1 CHECK CONNECTOR CONNECTION CONDITION (TORQUE SENSOR - ECU)**

- (a) Check the installation condition of the torque sensor connector.

**OK:**

**Torque sensor connector is securely installed to the power steering ECU.**

**Result**

Result	Proceed to
NG	A
OK	B

**B**

**Go to step 3**

**A**

**2 RECONFIRM DTC**

- (a) Reinstall the torque sensor connector.  
(b) Check for DTCs.

**OK:**

**DTC is not output.**

Result	Proceed to
DTC is output	A
DTC is not output	B

**B**

**END**

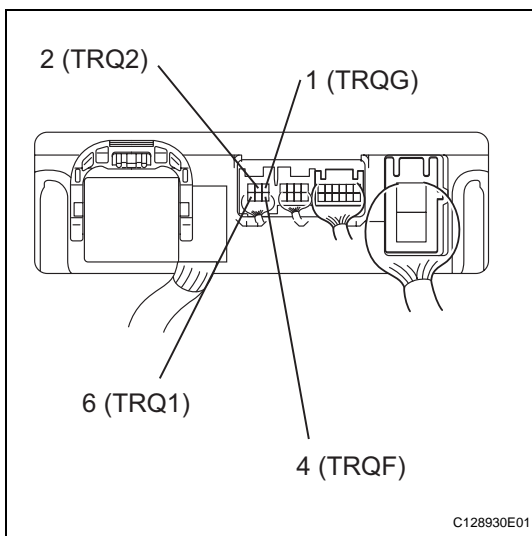
**A**

**3 INSPECT TORQUE SENSOR**

- (a) Turn the ignition switch ON.  
(b) Measure the voltage of the ECU.

**Standard voltage**

Tester Connection	Condition	Specified Condition
6 (TRQ1) - 1 (TRQG)	Steering wheel not turned (without load)	2.3 to 2.7 V
	Steering wheel turned to right with vehicle stopped	2.5 to 4.04 V
	Steering wheel turned to left with vehicle stopped	0.95 to 2.5 V



C128930E01

Tester Connection	Condition	Specified Condition
2 (TRQ2) - 1 (TRQG)	Steering wheel not turned (without load)	2.3 to 2.7 V
	Steering wheel turned to right with vehicle stopped	0.95 to 2.5 V
	Steering wheel turned to left with vehicle stopped	2.5 to 4.04 V
4 (TRQF) - 1 (TRQG)	Always	3.35 to 3.37 V
3 (TRQV) - 1 (TRQG)	Always	8.5 to 10.5 V

NG

REPLACE STEERING COLUMN ASSEMBLY

OK

PROCEED TO NEXT CIRCUIT INSPECTION SHOWN IN PROBLEM SYMPTOMS TABLE

DTC	C1521/25	Short in Motor Circuit
-----	----------	------------------------

DESCRIPTION

The power steering ECU supplies current to the power steering motor through this circuit.

DTC No.	DTC Detection Condition	Trouble Area
C1521/25	Motor over current	Power steering ECU

INSPECTION PROCEDURE

1	RECONFIRM DTC
---	---------------

- (a) Check for DTC.  
OK:  
DTC is not output.



PROCEED TO NEXT CIRCUIT INSPECTION  
SHOWN IN PROBLEM SYMPTOMS TABLE



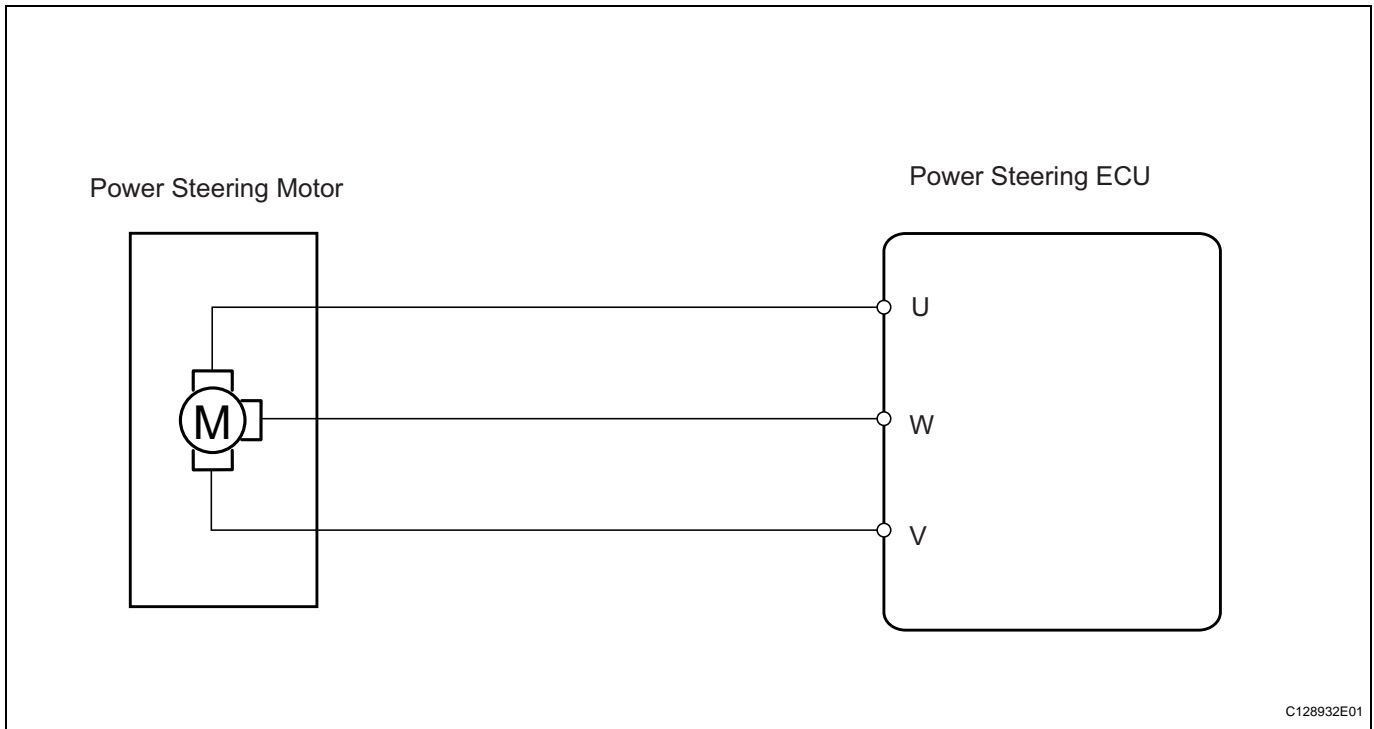
REPLACE POWER STEERING ECU
----------------------------



**DTC****C1524/24****Motor Terminal Voltage Malfunction****DESCRIPTION**

The power steering ECU supplies the current to the power steering motor through the motor circuit.

DTC No.	DTC Detection Condition	Trouble Area
C1524/24	Short (or open) in motor circuit or abnormal voltage or current in motor circuit	<ul style="list-style-type: none"> <li>Steering column assembly</li> <li>Power steering ECU</li> </ul>

**WIRING DIAGRAM****PS****INSPECTION PROCEDURE****1****READ VALUE OF INTELLIGENT TESTER (MOTOR VOLTAGE)**

- Connect the intelligent tester (with CAN VIM) to the DLC3.
- Turn the ignition switch ON and press the intelligent tester main switch ON.
- Select the items "MTR TERMINAL(U)", "MTR TERMINAL(V)", "MTR TERMINAL(W)" in the DATA LIST and read the value displayed on the intelligent tester.

**Power steering ECU**

Item	Item Description: Range (Display)	Inspection Condition	Reference Value
MTR TERMINAL(U)	Motor terminal voltage (U phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)

Item	Item Description: Range (Display)	Inspection Condition	Reference Value
MTR TERMINAL(V)	Motor terminal voltage (V phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)
MTR TERMINAL(W)	Motor terminal voltage (W phase): Min.: 0 V Max.: 46.667 V	Steering wheel is turned	While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (The value changes according to the steering load.)

**Result**

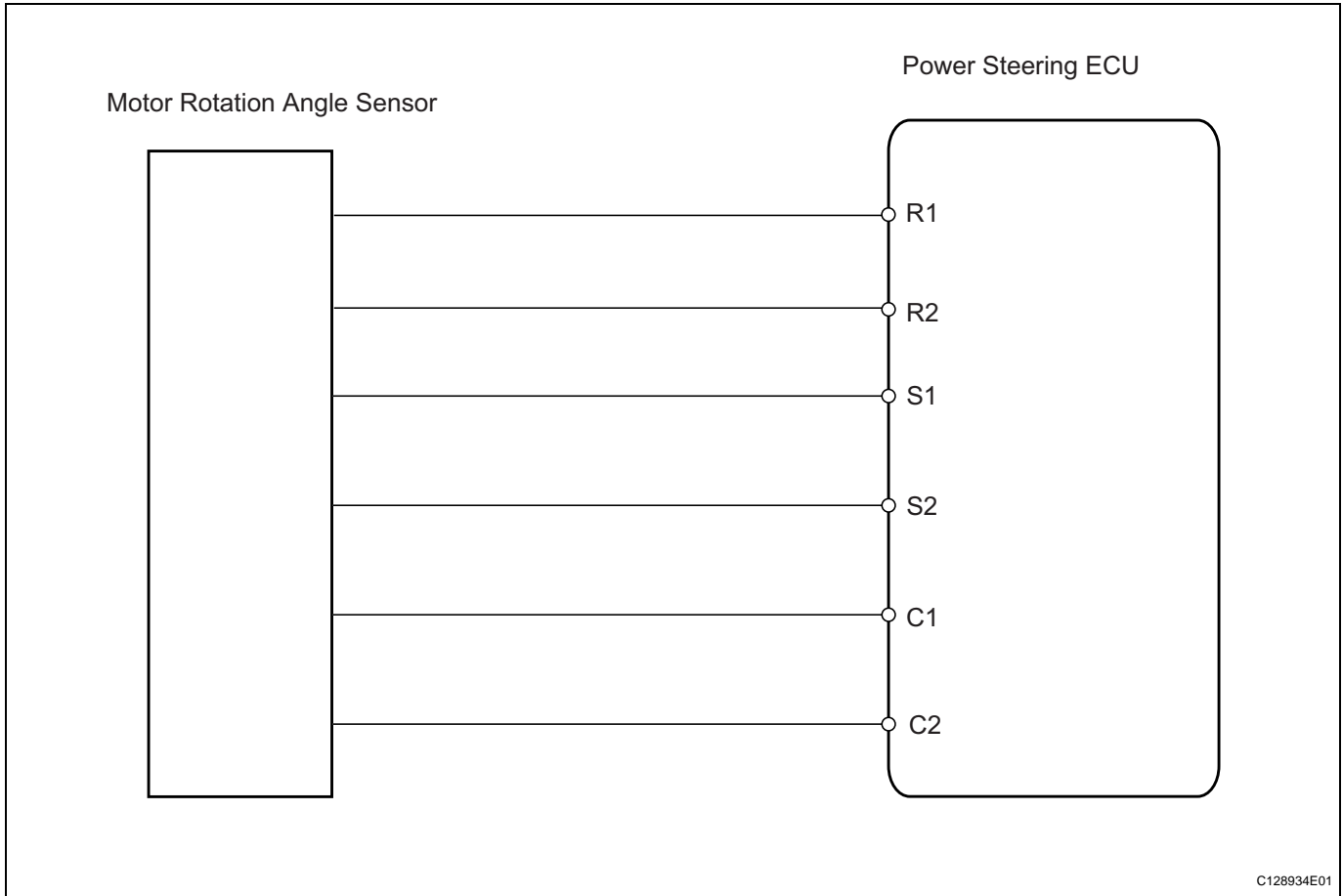
Result	Proceed to
While turning the steering wheel, a value within the range of 1 V to approximately 0.7 V less than the battery voltage is displayed. (Power assist is operating.)	A
While turning the steering wheel, 0 V or a value equal to the battery voltage is displayed. (Power assist is not operating.)	B

**B****REPLACE STEERING COLUMN ASSEMBLY****A****REPLACE POWER STEERING ECU**

**DTC****C1528/12****Motor Rotation Angle Sensor Malfunction****DESCRIPTION**

The motor rotation angle sensor detects the motor rotation angle and sends this information to the power steering ECU.

DTC No.	DTC Detection Condition	Trouble Area
C1528/12	Motor rotation angle sensor malfunction	<ul style="list-style-type: none"> <li>Steering column assembly</li> <li>Power steering ECU</li> </ul>

**WIRING DIAGRAM****PS****INSPECTION PROCEDURE****1****CHECK CONNECTOR CONNECTION CONDITION**

- (a) Check the installation condition of the motor rotation angle sensor connector.

**OK:**

**Motor rotation angle sensor connector is securely connected to the power steering ECU.**

**Result**

Result	Proceed to
NG	A
OK	B

B

Go to step 3

A

2

RECONFIRM DTC

- (a) Reinstall motor rotation angle sensor connector.
- (b) Check for DTC.

**OK:****DTC is not output.****Result**

Result	Proceed to
DTC is output	A
DTC is not output	B

B

END

A

3

READ VALUE OF INTELLIGENT TESTER (MOTOR ROTATION ANGLE SENSOR)

- (a) Connect the intelligent tester (with CAN VIM) to the DLC3.
- (b) Turn the ignition switch ON and press the intelligent tester main switch ON.
- (c) Select the items "MOTOR ROTATE" in the DATA LIST and read the value displayed on the intelligent tester.

PS

Item	Item Description: Range (Display)	Inspection Condition	Reference Value
MOTOR ROTATE	Motor Rotation Angle: Min.: 0° Max.: 360°	Steering wheel is turned	During steering operation, motor rotation angle value changes from 0 to 360°

**OK:****During steering operation, motor rotation angle value changes from 0 to 360°**

NG

REPLACE STEERING COLUMN ASSEMBLY

OK

REPLACE POWER STEERING ECU

<b>DTC</b>	<b>C1531/25</b>	<b>ECU Malfunction</b>
<b>DTC</b>	<b>C1532/25</b>	<b>ECU Malfunction</b>
<b>DTC</b>	<b>C1533/25</b>	<b>Temperature Sensor Circuit is Low or High</b>
<b>DTC</b>	<b>C1534/25</b>	<b>EEPROM Malfunction</b>

**DESCRIPTION****INSPECTION PROCEDURE**

If the power steering ECU detects these DTCs, it will shut off the motor relay circuit (built into the power steering ECU) and stop power assist. However, power assist continues if DTC C1533 is output.

<b>DTC No.</b>	<b>DTC Detection Condition</b>	<b>Trouble Area</b>
C1531/25	ECU internal malfunction (CPU malfunction)	Power steering ECU
C1532/25	ECU internal malfunction (Peripheral circuit malfunction)	Power steering ECU
C1533/25	ECU internal malfunction (Substrate temperature sensor malfunction)	Power steering ECU
C1534/25	ECU internal malfunction (EEPROM error)	Power steering ECU

<b>1</b>	<b>RECONFIRM DTC</b>
----------	----------------------

(a) Check for DTC.

**OK:**

**DTC is not output.**

**OK**

**PROCEED TO NEXT CIRCUIT INSPECTION  
SHOWN IN PROBLEM SYMPTOMS TABLE**

**NG**

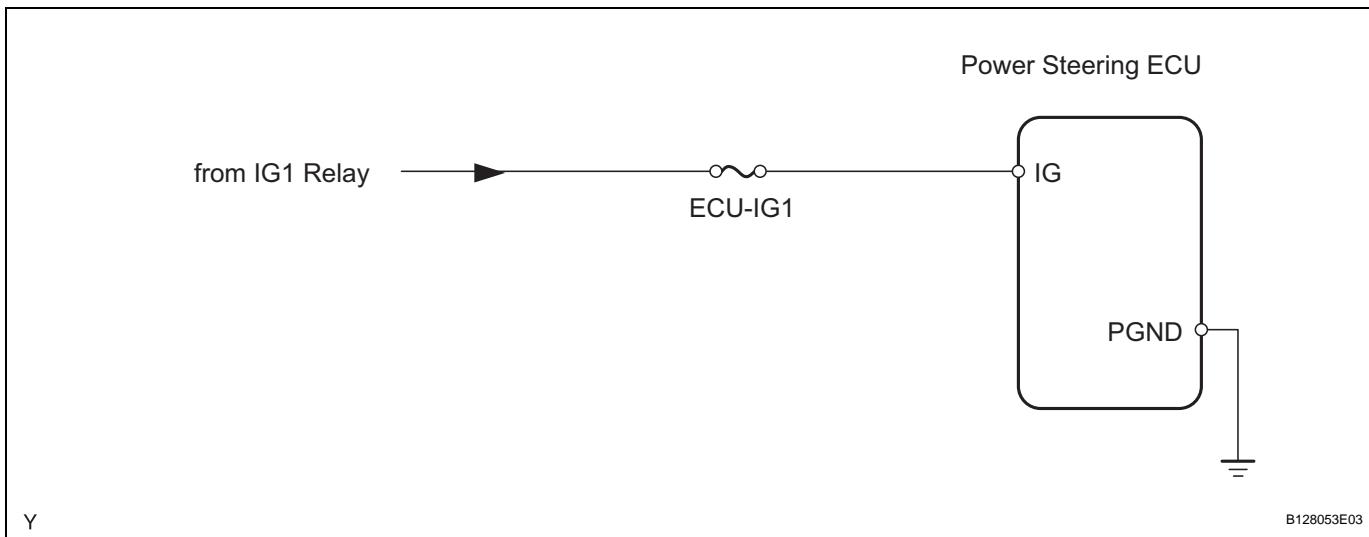
**REPLACE POWER STEERING ECU**

**PS**

**DTC****C1551/25****IG Power Supply Voltage Malfunction****DESCRIPTION**

The power steering ECU distinguishes the ignition switch status as ON or OFF through the IG power source circuit.

DTC No.	Detection Condition	Trouble Area
C1551/25	IG power source circuit malfunction inside ECU	<ul style="list-style-type: none"> <li>ECU-IG1 fuse</li> <li>IG power source circuit</li> <li>Power steering ECU</li> </ul>

**WIRING DIAGRAM****PS****INSPECTION PROCEDURE****1****READ VALUE OF INTELLIGENT TESTER (IG POWER SUPPLY)**

- Connect the intelligent tester (with CAN VIM) to the DLC3.
- Turn the ignition switch ON.
- Select the item "IG SUPPLY" in the DATA LIST and read the value displayed on the intelligent tester.

**Power steering ECU**

Item	Item Description: Range (Display)	Inspection Condition	Specified Condition
IG SUPPLY	IG power supply: Min.: 0 V Max.: 20.1531 V	Ignition switch ON	10 to 14 V

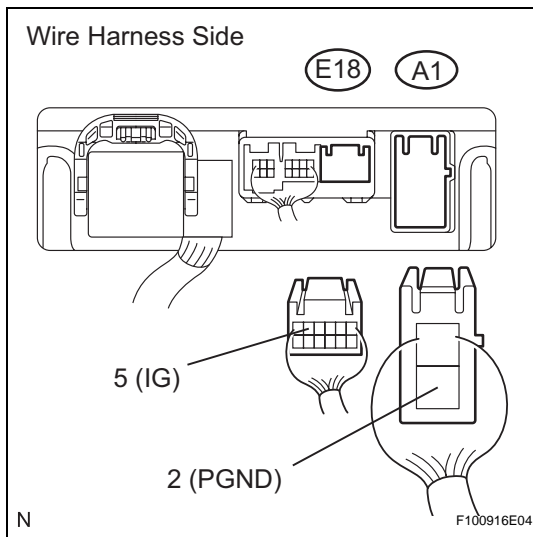
**OK****CHECK INTERMITTENT PROBLEMS****NG**

**2 INSPECT FUSE (ECU-IG1)**

- (a) Remove the ECU-IG1 fuse from the instrument panel junction block.
- (b) Measure the resistance of the fuse.

**OK:****Below 1  $\Omega$** **OK****NG****REPLACE FUSE****3 CHECK HARNESS AND CONNECTOR (BATTERY - POWER STEERING ECU)**

Wire Harness Side



- (a) Disconnect the E18 and A1 power steering ECU connectors.
- (b) Measure the voltage of the wire harness side connectors.

**Standard voltage**

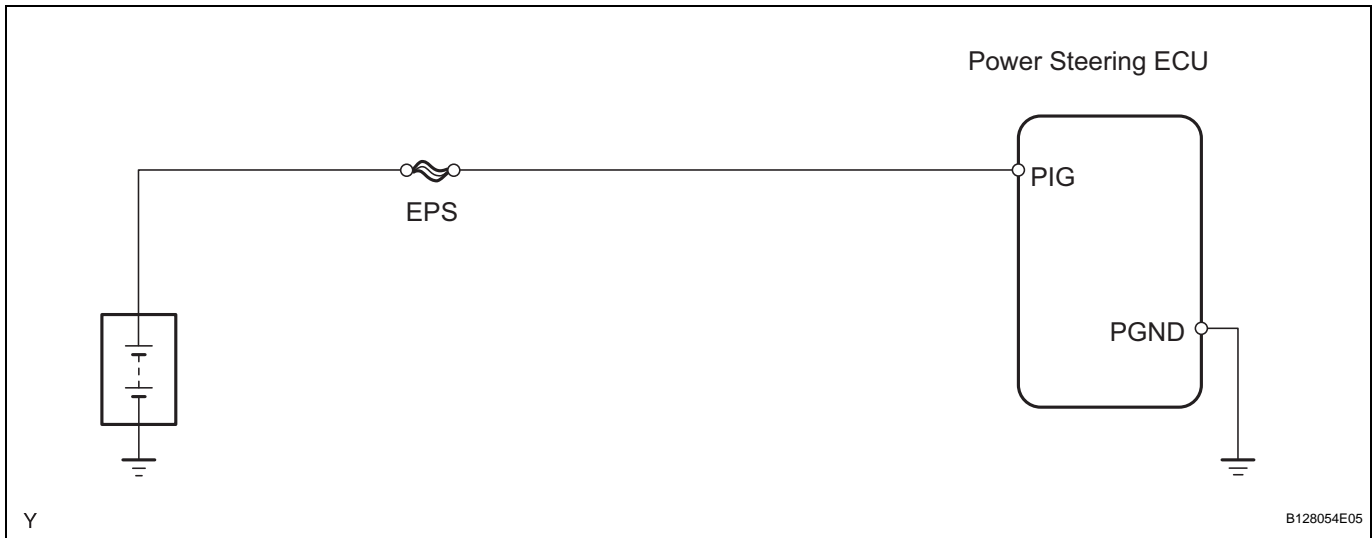
Tester Connection	Condition	Specified Condition
E18 -5 (IG) - A1-2 (PGND)	Ignition switch ON	10 to 14 V

**NG****REPAIR OR REPLACE HARNESS AND CONNECTOR****OK****REPLACE POWER STEERING ECU****PS**

**DTC****C1552/22****PIG Power Supply Voltage Malfunction****DESCRIPTION**

When a problem occurs in the system, the power source relay circuit is shut off to stop the power assist.

DTC No.	DTC Detection Condition	Trouble Area
C1552/22	PIG power source circuit malfunction inside ECU	<ul style="list-style-type: none"> <li>PIG power source circuit</li> <li>Power steering ECU</li> </ul>

**WIRING DIAGRAM****PS****INSPECTION PROCEDURE****1****READ VALUE OF INTELLIGENT TESTER (PIG POWER SUPPLY)**

- Connect the intelligent tester (with CAN VIM) to the DLC3.
- Turn the ignition switch ON.
- Select the item "PIG SUPPLY" in the DATA LIST and read the value displayed on the intelligent tester.

**Power steering ECU**

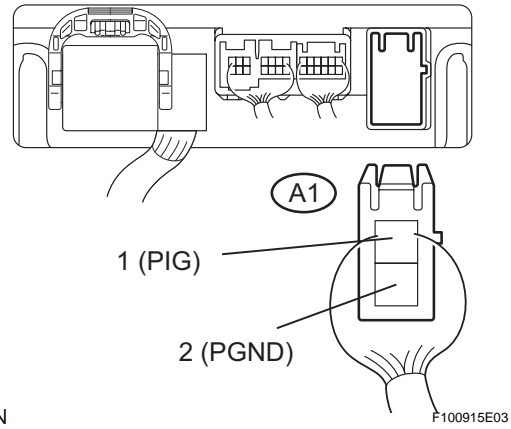
Item	Item Description: Range (Display)	Inspection Condition	Specified Condition
PIG SUPPLY	PIG power supply: Min.: 0 V Max.: 20.1531 V	Power steering in operation	10 to 14 V

**OK****CHECK INTERMITTENT PROBLEMS****NG**



2 CHECK WIRE HARNESS (BATTERY - POWER STEERING ECU)

Wire Harness Side



- (a) Disconnect the A1 power steering ECU connector.
  - (b) Measure the voltage of the wire harness side connector.
- Standard voltage**

Tester Connection	Specified Condition
A1 -1 (PIG) - A1-2 (PGND)	10 to 14 V

NG

REPAIR OR REPLACE HARNESS AND CONNECTOR

OK

REPLACE POWER STEERING ECU

<b>DTC</b>	<b>C1554/23</b>	<b>Power Supply Relay Failure</b>
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<b>DTC</b>	<b>C1555/25</b>	<b>Motor Relay Welding Failure</b>
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**DESCRIPTION**

If the power steering ECU detects these DTCs, it shuts off the motor relay circuit (built into the power steering ECU) and stops power assist.

<b>DTC No.</b>	<b>DTC Detection Condition</b>	<b>Trouble Area</b>
C1554/23	Power source relay circuit malfunction	Power steering ECU
C1555/25	Motor relay circuit malfunction	Power Steering ECU

**INSPECTION PROCEDURE**

<b>1</b>	<b>RECONFIRM DTC</b>
----------	----------------------

(a) Check for DTC.

**OK:**

**DTC is not output.**

**OK**

**PROCEED TO NEXT CIRCUIT INSPECTION  
SHOWN IN PROBLEM SYMPTOMS TABLE**

**NG**

**REPLACE POWER STEERING ECU**

**DTC****C1581/26****Assist Map Number Un-Writing****DESCRIPTION**

The power steering ECU outputs this DTC when it determines that the assist map is not written in the ECU.

**HINT:**

The assist map data is written in the power steering ECU to control assisting power.

The assist map has 3 types. Select an assist map according to the vehicle country information that is recorded in the ECU.

DTC No.	DTC Detection Condition	Trouble Area
C1581/26	Assist map not written in power steering ECU	Power steering ECU

**INSPECTION PROCEDURE****1****PERFORM ASSIST MAP WRITING**

- (a) Turn the ignition switch ON.
- (b) Connect the intelligent tester (with CAN VIM) to the DLC3.

**HINT:**

At this time, check that the P/S warning light is illuminated.

- (1) Select signal check, and change to test mode.
- (c) Wait for 3 seconds.

**NEXT****2****CHECK P/S WARNING LIGHT**

- (a) Check the P/S warning light.

**Result**

Result	Proceed to
P/S warning light illuminates	A
P/S warning light blinks at 0.25 second intervals	B

**HINT:**

If the P/S warning light blinks at 0.25 second intervals, the assist map adjustment has completed normally.

**B****END****A****3****CHECK DTC**

- (a) Check for DTC.

**Result**

Result	Proceed to
C1581/26 output Assist map write adjustment operation not completed 3 times or more	A

**PS**

Result	Proceed to
Code other than C1581/26 is output	B
C1581/26 output Assist map write adjustment operation not completed less than 3 times	C

HINT:  
If DTC C1581/26 is output, turn the ignition switch OFF. Enter test mode again. If the DTC is output 3 times in a row, replace the power steering ECU.

B

REFER TO DTC

C

Go to step 1

A

REPLACE POWER STEERING ECU

<b>DTC</b>	<b>U0073/49</b>	<b>Control Module Communication Bus Off</b>
<b>DTC</b>	<b>U0105/41</b>	<b>Lost Communication with Fuel Injector Control Module</b>
<b>DTC</b>	<b>U0121/42</b>	<b>Lost Communication with Anti-Lock Brake System (ABS) Control Module</b>

**DESCRIPTION**

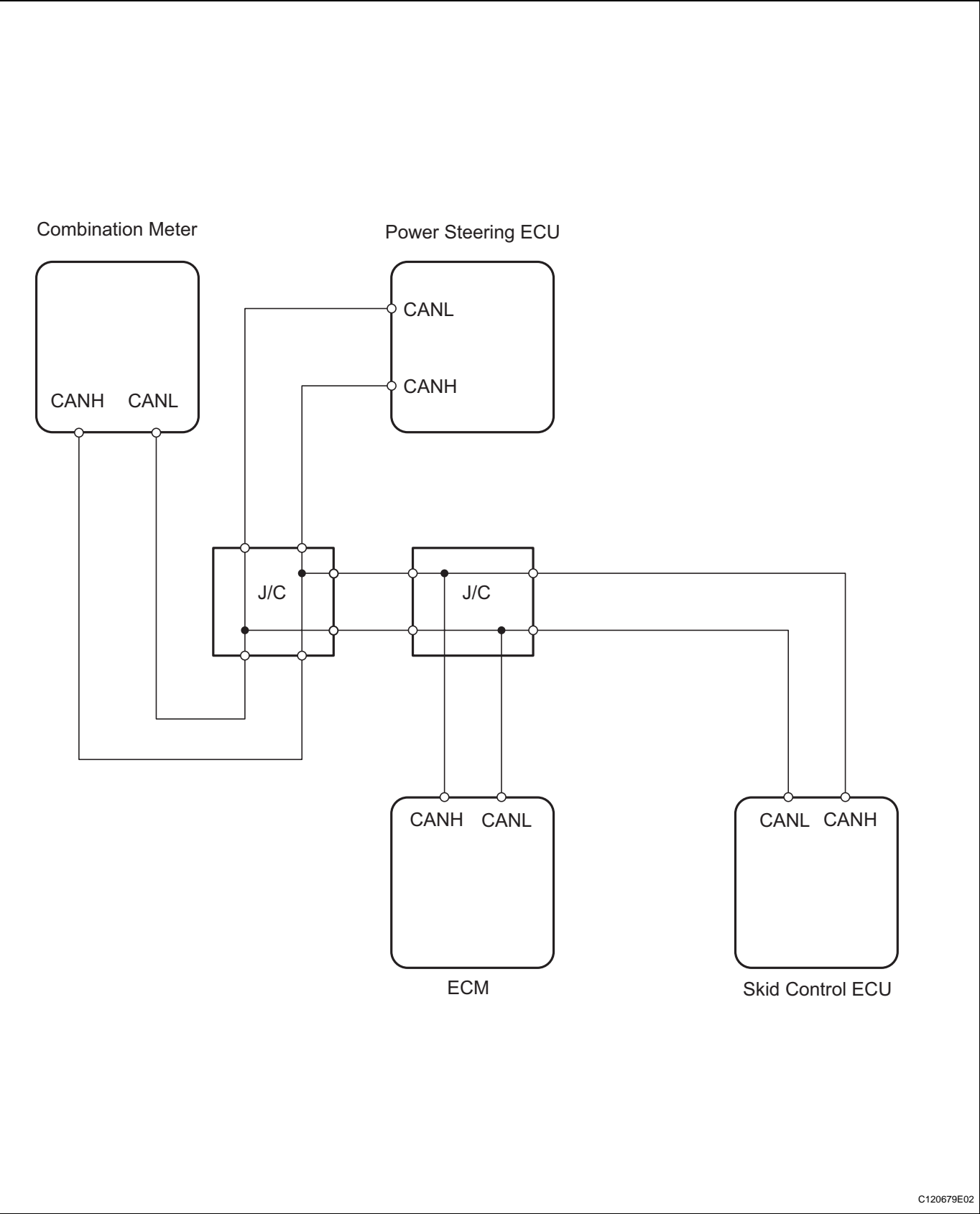
The power steering ECU receives signals from the ECM and the skid control ECU via the CAN communication system.

<b>DTC No.</b>	<b>DTC Detection Condition</b>	<b>Trouble Area</b>
U0073/49	Control Module Communication Bus Off	CAN communication system
U0105/41	Lost Communication with Fuel Injector Control Module	<ul style="list-style-type: none"> <li>• CAN communication system</li> <li>• ECM</li> </ul>
U0121/42	Lost Communication with Anti-Lock Brake System (ABS) Control Module	<ul style="list-style-type: none"> <li>• CAN communication system</li> <li>• Skid control ECU</li> </ul>

**HINT:**

- When 2 or more DTCs starting with [U] are output simultaneously, inspect the connectors and wire harness of each ECU.
- If DTC U0105/41 is output, first erase the DTCs. Then turn the ignition switch from OFF to ON. If DTC U0105/41 is not output again, there is no malfunction.

WIRING DIAGRAM



**INSPECTION PROCEDURE****1 RECONFIRM DTC**

(a) Check for DTC.

**OK:****DTC is not output.****OK****PROCEED TO NEXT CIRCUIT INSPECTION  
SHOWN IN PROBLEM SYMPTOMS TABLE****NG****GO TO CAN COMMUNICATION SYSTEM**

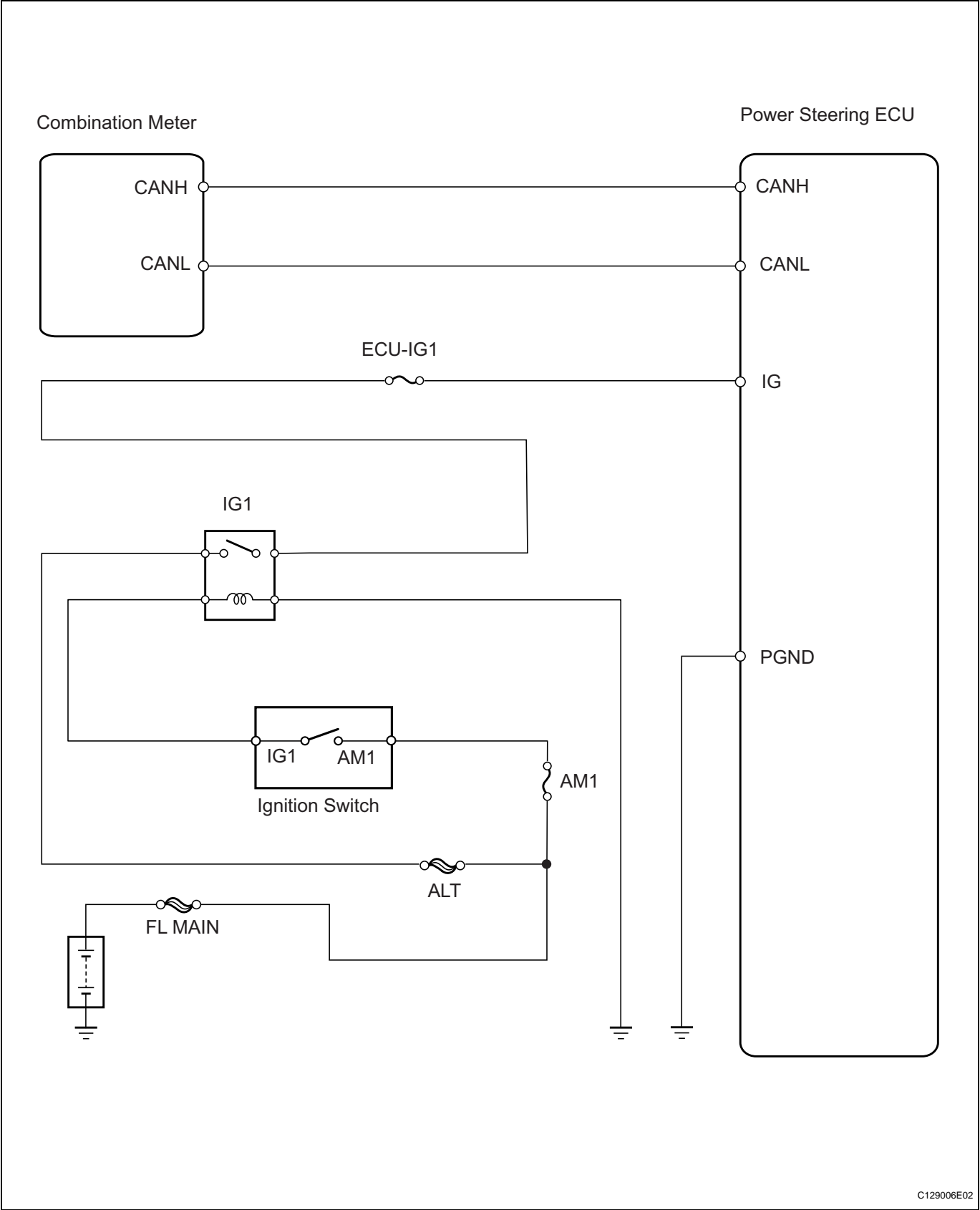
## EPS Warning Light Circuit

### DESCRIPTION

If the power steering ECU detects a malfunction, the P/S warning light comes on. At this time, the power steering ECU stores a DTC in its memory.



WIRING DIAGRAM



PS

## INSPECTION PROCEDURE

**1 CHECK FOR DTC**

- (a) Using the intelligent tester (with CAN VIM), check for DTCs and confirm that there are no problems in the CAN communication system.

**OK:**

**CAN DTCs are not output.**

**NG**

**GO TO CAN COMMUNICATION SYSTEM**

**OK**

**2 READ VALUE OF INTELLIGENT TESTER (IG POWER SUPPLY)**

- (a) Connect the intelligent tester (with CAN VIM) to the DLC3.
- (b) Turn the ignition switch ON and press the intelligent tester main switch ON.
- (c) Select the item "IG SUPPLY" in the DATA LIST and read the value displayed on the intelligent tester.

**Main body ECU**

Item	Item Description: Range (Display)	Inspection Condition	Specified Condition
IG SUPPLY	ECU power source voltage: Min.: 0 V Max.: 20.1531 V	Ignition switch ON	10 to 14 V

**OK**

**Go to step 5**

**NG**

**3 INSPECT FUSE (ECU-IG1)**

- (a) Remove the ECU-IG1 fuse from the instrument panel junction block.
- (b) Measure the resistance of the fuse.

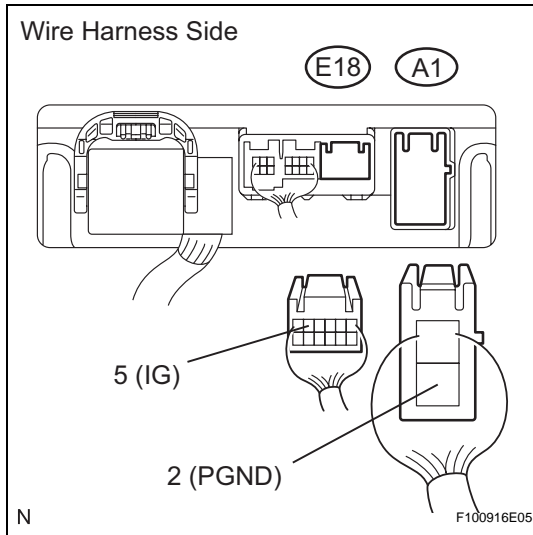
**OK:**

**Below 1  $\Omega$**

**NG**

**INSPECT SHORT CIRCUIT IN COMPONENTS AND WIRES CONNECTED TO FUSE**

**OK**

**4 CHECK WIRE HARNESS (BATTERY - POWER STEERING ECU AND BODY GROUND)**

- (a) Disconnect the A1 and E18 power steering ECU connector.
- (b) Measure the voltage of the wire harness side connectors.

**Standard voltage**

Tester Connection	Condition	Specified Condition
E18-5 (IG) - A1-2 (PGND)	Ignition switch ON	10 to 14 V

**NG****REPAIR OR REPLACE HARNESS AND CONNECTOR****OK****5 PERFORM ACTIVE TEST BY INTELLIGENT TESTER**

- (a) Connect the intelligent tester (with CAN VIM) to the DLC3.
- (b) Turn the ignition switch ON and press the intelligent tester main switch ON.
- (c) Operate the intelligent tester according to the steps on the display and select the ACTIVE TEST.

**PS****Combination meter**

Item	Test Details	Diagnostic Note
EPS INDIC	P/S indicator (ON/OFF)	Confirm that the vehicle is stopped, engine idling

**OK:****Indicator comes on.****NG****REPLACE COMBINATION METER ASSEMBLY****OK****REPLACE POWER STEERING ECU**